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UNRAVELLING THE TRIAD:

ARMS TRANSFERS, INDIGENOUS DEFENSE PRODUCTION, AND DEPENDENCY  
IRAN AS AN EXAMPLE,

(18) 351

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(11) 1979

Submitted in partial fulfillment of contract DOS #1722-820168

(18) FAR (19) 3012

DOS 1722-820168

An earlier version of this paper was presented at the American Political Science Association Conference, Washington, D.C., August 31-September 3, 1979.

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UNRAVELING THE TRIAD: ARMS TRANSFERS, INDIGENOUS  
DEFENSE PRODUCTION, AND DEPENDENCY --  
Iran As An Example

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Columbia University

Introduction

Manufacturing defense items is not a cost-effective enterprise for most countries. Few countries in the world, whether more or less developed, can produce military technology as economically as can the United States and some European states. Why then are more and more governments clamoring for licensing rights to produce arms indigenously rather than buying directly from major suppliers?

→ This paper analyzes the relationship between the military industrial capabilities of third world countries and their dependency on the states which supply them with arms. It focuses on the tension between the foreign policy goal of independence, which leads many governments to establish a domestic military industry, and the internal constraints which prevent them from achieving their goal. It discusses the kinds of tradeoffs third world defense planners must make between economic factors and perceived security needs.

Two main hypotheses serve as the organizational framework for this paper:

1. Arms transfers to less industrialized countries (LICs) initiate an evolutionary progression toward the indigenous production of military technology.

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2. Dependency for third world states is no less a product of indigenous defense production than of arms transfers. K

Although these hypotheses are formulated in general terms to apply to all third world states, the Iranian Air Force (IIAF) in particular is used for the purpose of illustration. Iran was chosen for several reasons. First, during the 1960s and 1970s the Iranian military acquired a large number of arms which spanned the spectrum of sophistication, from simple to advanced. This is particularly true for the Iranian Air Force.

Second, Iran received arms transfers for a relatively long period of time, from a variety of suppliers, under a number of different financial agreements. Thus Iran, because of its relatively long and diversified history of arms transfers, provides a unique research opportunity to study the relationship between economics and defense within the military sector over time. If there are common elements in the defense planning of third world leaders, this paper assumes they are most likely to appear in the policies of those countries which have had extensive procurement experience. The present writer hopes that others will be stimulated to test the validity of these research assumptions and hypotheses with other case studies.

#### The Escalator of Development

Hypothesis 1: Arms transfers to less industrialized countries initiate an evolutionary progression toward the indigenous production of military technology.

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It is hypothesized here that arms transfers and the indigenous production<sup>1</sup> of military equipment are part of the same development continuum. As the first shipment of military equipment<sup>arrives,</sup> an "escalator of development"<sup>2</sup> begins with the support of imported technology and ends with the production of components and/or total weapons systems. The stages of this developmental process, although varying widely in time intervals across countries, are so intimately connected to the arms transfer process that the dividing line between indigenous production and arms transfers is often indistinguishable.

Beginning with the delivery of the first weapon system, the sequence follows a predictable, although not necessarily orderly pattern. It is characterized at each stage by increasing recipient participation:

1. Servicing and repair of imported weapons systems
2. Overhaul of imported weapons systems
3. Weapon system assembly under license

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<sup>1</sup>The term "production" is used here in the generic sense to include all phases of the maintenance and/or manufacture of defense items. This usage conforms to the U.S. Department of Defense definition of co-production which encompasses any program which "enables an eligible foreign government, international organization or designated commercial producer to acquire the 'know-how' to manufacture or assemble, repair, maintain and operate, in whole or in part, a specific weapon, communication or support system, or an individual military item." (U.S. Department of Defense Directive 2000.9 (ASD-I and L), International Co-production Projects and Agreements Between the United States and Other Countries or International Organizations, Jan. 23, 1974.)

<sup>2</sup>Daniel L. Spencer, "An External Military Presence, Technological Transfer, and Structural Change," *Kyklos* 19 (1965), 451-73.

4. Fabrication of simple components under license
5. Co-production of weapon systems under license
6. Indigenous design and development

The first two maintenance phases of the developmental sequence are generally the most difficult and time consuming to achieve in any service. The U.S. Air Force has identified three different levels of technical expertise necessary for the operation and maintenance of defense equipment:<sup>1</sup>

1. Base or Organizational Level Maintenance: This, the most elementary kind of maintenance, is essentially a servicing operation (such as gassing, lubrication, etc.) which includes making minor repairs by removing and replacing spare parts. Work is performed on, or in direct support of, an aircraft on the flight line or in the inspection dock.

2. Intermediate Level Maintenance: At this level, work is performed on aircraft systems, sub-systems, and components which have been removed from the aircraft and brought to a shop (generally on the base). This is synonymous with "off aircraft" maintenance and is often referred to as the "shop" or "field shop" part of "base maintenance." Mechanics at this level are trained to do minor internal

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<sup>1</sup>Operational skills (such as flying and weapons operations) are omitted from this discussion since they are less related to "the escalator of development" toward indigenous production than maintenance skills.

repairs of components (e.g. hydraulic cylinders) which can be pulled apart if necessary, certain parts replaced, and then reassembled.

3. Depot Level Maintenance: The most complicated repairs are done at this level, generally off base at a designated military or commercial facility where components are sent for complete teardown and reassembly. This kind of maintenance encompasses the major inspection and repair as necessary (IRAN) maintenance functions which include overhaul and modification of the airframe, the aircraft system, subsystems and components. It involves the repair of equipment that cannot be done at the base level and requires a higher technological skill than either of the other two forms of maintenance. As one industry employee commented: "Once you learn how to tear down and reassemble an aircraft, the capability for domestic production of aerospace components is relatively easy to acquire."

This ascending order of fundamental maintenance tasks suggests a close connection between support and production, and the kinds of basic skills necessary to master these capabilities. The limits to growth of the military sector in any particular country are clearly dictated by the number and complexity of systems to be supported or produced, and the <sup>technical</sup> skill level of the population. But, the size of a country and its level of industrial development are equally important factors. In all military services, the decision to establish a depot level facility is determined not only by the skilled manpower resources available, but by economies of scale. In many smaller

countries, the force structure of the military cannot sustain a depot level industry. In the air force, for example, there are often not enough planes to keep a depot busy and so it is more economical to have major repairs done elsewhere. For most developing countries, major repairs are sent to depot level shops in either the U.S. or Europe. Only Israel and Taiwan are known to have depots of their own.

To comprehend any country's technical ability and its potential for indigenous military production, one would need information about the level of competency in many skills throughout the military sector, and some concept of the existing industrial infrastructure. The simple 6 x 6 matrix below includes only some of the data categories needed to estimate domestic military-industrial capabilities.<sup>1</sup> The "escalator of development" can be thought of as operating across weapons systems, services, time, and countries. Thus the aircraft industry in country X can be at one level of development, while naval production is at another. The reverse kind of production capability may be characteristic of country Y. The discussion of Iran (below) will elaborate on the number of human and material resources necessary to acquire an indigenous production capability in one military service. The matrix included here is designed to help the reader graphically imagine the vast resources required for an 'across the board' capability in the other military services as well. Little wonder so few countries have been able to attain it.

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<sup>1</sup> To describe more fully a particular country's defense industrial capability, a matrix would have to indicate the kind of military items being "produced" and their level of sophistication. For example, country X with a capability to overhaul a J-79 engine has acquired more sophisticated skills than country Y which assembles rifles. This same kind of differential may apply to different services within the same country, too.



# The Escalator of Development

## Matrix of Technical Skills in Ascending Order of Sophistication Across Weapon Systems

	Aircraft	Missiles	Ships	Armored Vehicles	Small Arms Ammo.	Electronics
Servicing & Repair						
Overhaul						
Assembly (License)						
Fabrication of Simple Components (License)						
Co-Production (License)						
Indigenous Design & Production						

The Iranian Air Force: The Iranian Air Force, between 1964 and 1978, was confronted with the task of modernizing rapidly. Although the large number of arms transferred to Iran, their degree of sophistication, and the short time span within which the deliveries were made is not typical for most less industrialized countries, the fact that so much happened so quickly affords us a condensed, or "fast-forward" glimpse of the stages of development within the military.

For all practical purposes, the modernization of the Iranian Air Force, began with the delivery of 106 F-5A/B supersonic jet fighters in 1964. Between 1968 and 1970, 39 more F-5s arrived -- a total of 145 F-5s to be absorbed within seven years.<sup>1</sup> In addition to these transfers, 10 C-130 transports were delivered between 1968 and 1970<sup>2</sup> and 36 US F-4 fighter jets (the workhorse of the USAF in Vietnam and the state-of-the-art air system at that time).<sup>3</sup> By 1978, there were 64 C-130s in Iran's inventory, and twenty Boeing 707 and 747 to supplement the transport force. Iran had received over 200 F-4s;<sup>4</sup> 169 of the latest model F-5E/F; and 78 F-14A fighter jets,<sup>5</sup> the latter one of the most sophisticated aircraft in the U.S.

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<sup>1</sup>DMS Market Intelligence Report, 1979, "Iran Force Structure, Aircraft."

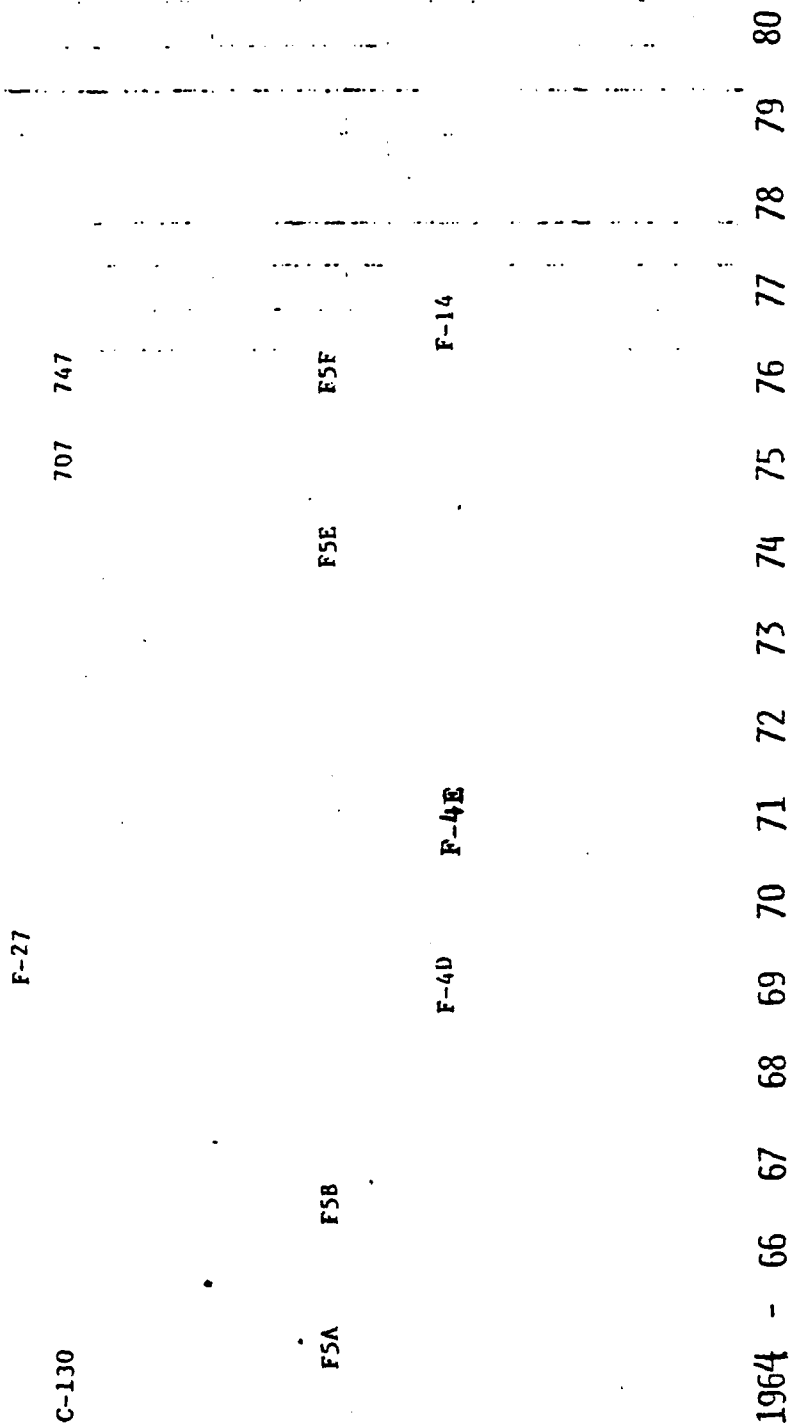
<sup>2</sup>Ibid. According to other sources some C-130s arrived as early as 1964-65. Figure 1 uses the earlier date.

<sup>3</sup>The F-5E/Fs were purchased to replace the F-5A/Bs. During the early 1970s, an undetermined number of the F-5A/Bs were transferred to Pakistan, South Vietnam, Jordan, and Greece, according to the DMS Market Intelligence Report, 1979.

<sup>4</sup>Ibid.

<sup>5</sup>Ibid.

# 11AF AIRCRAFT HISTORY



CALENDAR YEAR

Figure 1

inventory, which the U.S. Navy was still having problems absorbing. Thus, collapsed into a fourteen year period, and not counting training planes, helicopters, and other smaller air force programs, the IIAF was tasked with the maintenance and operation of seven major weapons systems approximating 500 aircraft (see Figure 1).

To accomodate this equipment, the IIAF had grown to a strength of 100,000 men, with operational units which included 10 fighter-bomber squadrons, 10 ground attack squadrons, one reconnaissance squadron, one tanker squadron, four medium and four light transport squadrons, and five surface to air squadrons.<sup>1</sup> By 1978, arms transfers from the U.S. had made the IIAF inventory one of the most modern in the world.

In order to effectively utilize these systems, however, the Iranians were faced with the overwhelming job of training enough technical and managerial personnel to perform the necessary operational, maintenance, and logistical functions.

It is estimated that over 10,000 trained managers and technicians were required (excluding depot manning personnel) to maintain in operable condition just the F-5, F-4, and F-14 systems in Iran's inventory in 1978 (see Figure 2).<sup>2</sup> Of this 10,000, approximately

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<sup>1</sup>DMS Market Intelligence Report, 1979.

<sup>2</sup>The 10,000 plus manpower requirement is estimated by dividing the number of F-5s, F-4s, and F-14s in the Iranian inventory (1978) by 18 (into U.S. squadrons) and then multiplying the total maintenance manpower requirement for each jet type (see Figure 2) by number of squadrons. Thus, in 1978 the IIAF had 181 F-5s, 225 F-4s, and 78 F-14s; translated into squadrons this becomes approximately 10 F-5 squadrons, 13 F-4 squadrons, and 4 F-14 squadrons.

FIGURE 3

DISTRIBUTION OF MAINTENANCE TECHNICAL SKILL LEVEL

	<u>F-5 E/F</u>		<u>F-4 E</u>		<u>F-14</u>		Total Manpower Requirement
	per 18 ac	per 181 ac *	per 18 ac	per 225 ac *	per 18 ac	per 48 ac *	
Superintendent <sup>1</sup> (9 level)	8	80	12	156	14	56	292
Technician <sup>2</sup> (7 level)	50	500	83	1079	99	396	1975
Specialist <sup>3</sup> (5 level)	138	1380	228	2964	272	1088	5432
Semi-Skilled <sup>4</sup> Specialist (3 level)	54	540	93	1209	111	444	2193 9892

<sup>1</sup> Chief administrator - responsible for overall administration (similar to a licensed doctor who does not practice but administers a hospital). 8- years of experience on the job.

<sup>2</sup> Administration with some "hands-on." Responsible for keeping a specific operation going. 5-10 years of experience.

<sup>3</sup> Expert technician with 1-5 years of experience

<sup>4</sup> Trained technician with no on-the-job experience. Finished specialty course, just beginning on-the-job training.

\* Total number of aircraft in the Iranian inventory (1978)  
[Computed from the DMS Market Intelligence Report, 1979]

FIGURE 2

MAINTENANCE MANPOWER REQUIREMENTS

	F-5E/F (181) <sup>4</sup>	F-4E (225) <sup>4</sup>	F-14 (78) <sup>4</sup>
Direct <sup>1</sup>	116	226	292
Indirect <sup>2</sup>	111	152	159
Overhead <sup>3</sup>	23	38	45
	<u>250*</u>	<u>416*</u>	<u>496*</u>
Number of planes in inventory/18	10	13	4

\* Number of personnel determined for 18 aircraft; 25 flying hours/ aircraft/month (FH/MO); 85.2 maintenance manhours/man/month.

<sup>1</sup> Direct maintenance refers to base and intermediate level maintenance.

<sup>2</sup> Indirect maintenance refers to fixed number<sup>5</sup> of technicians needed to support maintenance and operations (e.g., support, precision measurement and laboratory equipment, weapons loading, weapons release, gun services, munitions maintenance, storage, and handling).

<sup>3</sup> Overhead maintenance includes management, staff, and administration.

<sup>4</sup> Total number of aircraft in the Iranian inventory (1978)  
[Computed from the DMS Market Intelligence Report, 1979]

one-fourth needed managerial and technical skills (see Figure 3) requiring 5-10 years of training and "hands-on" experience.<sup>1</sup>

A large training program was instituted in the U.S. and Iran to meet this and other IIAF technical needs. Between 1964 and 1972, 4,609 Iranians were trained (under MAP and FMS<sup>2</sup> in U.S. Air Force (USAF) technical schools. By 1977, 5,954 more had been trained, a total of 10,563 men.<sup>3</sup> Thousands more were learning maintenance functions in on-the-job training (OJT) in Iran with hundreds of U.S. contractor and airforce technical training teams instructing them.

As plans for acquiring a large modern air force took shape within the Iranian military, the Shah and his advisers decided in 1968 to begin developing a depot level maintenance capability in-country. By 1968, large numbers of F-5s and C-130s were in inventory and F-4s had just begun to arrive. Many more planes were expected in the future. To the Shah, the speed with which the aircraft were delivered and their numbers indicated that unless Iran established an independent maintenance and overhaul capability its dependence on the U.S. for technical expertise and spare parts would become permanent. Iran's geopolitical position and long experience with foreign intervention in its affairs only served to reinforce the Shah's desire for self-sufficiency.<sup>4</sup>

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<sup>1</sup>Interview with a U.S. Army Colonel who served in Iran with the U.S. Military Assistance Advisory Group (MAAG) as an administrator of the U.S Foreign Military Sales program (FMS) to Iran.

<sup>2</sup>MAP= Military Assistance Program (U.S.); See fn. above for FMS definition.

<sup>3</sup>These figures were supplied by the U.S. Defense Security Assistance Agency (DSAA) and unfortunately do not break out operations from maintenance. The 10,563 figure includes pilots and weapons operators.

<sup>4</sup>Interview with General Toufanian, Teheran, Iran, January 1978.

The depot was an ideal vehicle with which to realize his foreign policy and strategic goals: (1) Self sufficiency: The Shah's short term goal was to establish an indigenous capability to perform enough maintenance and fabrication of spare parts to service the IIAF's strategic needs without outside assistance. His long-term objective was to develop a research and manufacturing capability similar to that of Israel Aircraft Industries, with the ultimate aim the production of an aircraft suited to Iran's particular defense needs; (2) Establishing Iran as the major military power in the Middle East: In the short-term Iran's role in the Middle East would be enhanced by servicing, maintaining, and overhauling aircraft for the entire region. Doing so would also enlarge the scale of the depot's activities, turning it into a more economically viable venture. Long range plans included the production of aircraft to fill regional needs.<sup>1</sup>

In September 1970, the Iranian Aircraft Industries (IACI) was formed as a joint venture between the Northrop Corporation and the Iranian Military Industrial Organization (MIO) to train middle

<sup>1</sup>Interview with Iran Aircraft Industries (IACI) personnel, Teheran, Iran, December 1977.



management technicians.<sup>1</sup> The middle-term objectives were maintenance and logistics support for the IIAF and perhaps for Iran Air. Long term goals included license production for fasteners and spare parts; overhaul work on some components for the whole Middle East; assembly and some fabrication on remotely piloted vehicles (RPV), light civilian and transport planes, and the F-18 jet fighter (in ascending order), with eventual research and development of an F-X fighter and other aircraft. The time frame for this progression of events was estimated to be 20 years.<sup>2</sup>

By 1975 Northrop had sold its interest in IACI to the Iranian government and in 1977 IACI contracted with Lockheed Aircraft Service Co. to expand its aircraft overhaul and maintenance capabilities. When completed in the early 1980s the facility at Mehrabad Airport,

<sup>1</sup>The Company's charter stated:

"1. The Government of Iran has determined that IACI is vital to the national interest and will:

Establish and expand military and commercial aircraft repair, maintenance and overhaul capability; satisfy a critical need with respect to national defense and commercial aircraft requirements; provide management and technical expertise through on-the-job and other IACI training programs.

2. IACI will also as directed:

Manufacture, through license, coproduction, or internal design and development, air vehicles and air vehicles systems either governmental or commercial; provide a basis for the planning and development of a self-sufficient aerospace industry.

It is the intention of the Government of Iran that IACI be a vital link in the development of self-sufficiency, and that it serve not only as the major overhaul, modification, manufacturing, and repair center for all Iranian aircraft but serve also as the base for developing a self-sufficient Aerospace Industry. IACI Management and Shareholders are dedicated to this task." Preface to Iran Aircraft Industries; Executive Briefing Progress Report, September 1975.

<sup>2</sup>Interviews with Northrop personnel, February 1979.

Teheran was to be the most modern and one of the largest aircraft and engine service facilities in the world. The facility was designed to handle all Iranian military and civil aircraft and would support aircraft and engine overhaul requirements throughout the Middle East.<sup>1</sup>

By early 1978 an infant manufacturing capability was in fact in the process of being developed in Iran to support, for the most part, the Iranian aerospace program. The DMS Market Intelligence Report stated:

The Imperial government negotiated contracts with several aerospace companies that created significant co-production agreements. By early 1979 agreements had been concluded that would have eventually enabled Iranian industry to produce aircraft, helicopters, advanced computer terminal products, electro-optical products and surface-to-air missiles.<sup>2</sup>

Together 7 co-production contracts had been signed by early 1979:

1) Helicopter production and maintenance: In 1975 Bell Helicopter was contracted to establish two capabilities, one a depot level maintenance and logistic center which would also supply training and support services for the Bell Helicopters acquired from the U.S., and the second, construction and operation of an Iranian helicopter industry. Initial production was scheduled to start in 1979 to build 400 advance model helicopters. Included was a training program to instruct Iranian personnel to assemble, produce, operate, and manage the industry, which eventually would be turned over to the Iranian government.<sup>3</sup>

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<sup>1</sup>DMS, "Iran Summary," p. 6, and interviews with MAAG personnel, July 1979.

<sup>2</sup>DMS, "Iran Summary, p. 4.

<sup>3</sup>Bell suspended work in 1978 and the contract was subsequently cancelled.

2) Co-production of the Rapier ground-to-air missile: In 1976 Iran Electronics Industries (IEI), (a subsidiary of the Iranian Military Organization (MIO), which had been established to form an electronics manufacturing capability in Iran) formed a joint company with British Aerospace Dynamics (BAC) (65% financed by IEI and 35% by BAC),<sup>1</sup> to manage a program leading to co-production of the Rapier. As an interim measure Iran was to procure the missiles directly from BAC and install them.<sup>2</sup>

3) TOW missile: In 1976 Iran concluded an agreement with Emerson Electronics and Hughes for co-production of the TOW anti-tank missile and launcher.<sup>3</sup>

4) Switch Manufacturing Capability: In early 1975, IEI joined with GTE in a joint venture to supply Iran with electronic switching equipment for telecommunications and to establish a switch manufacturing plant.

5) Computer Terminal Products: IEI and Control Data Corporation established a jointly-owned company to design, develop, and manufacture advanced computer terminal products.<sup>4</sup>

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<sup>1</sup>SIPRI Yearbook, 1979, p. 165.

<sup>2</sup>In late 1978 the Iranian government cancelled plans to build the system in Iran. DMS, "Iran Summary," p. 5.

<sup>3</sup>SIPRI Yearbook, 1979, p. 165, and Institute for Policy Studies, Arms Trade Data, "U.S. Arms Transfer to the Third World, 1973-78." (n.d.)

<sup>4</sup>DMS, p. 5.

6) Maverick Missile: In Spring 1978 IEI and Hughes contracted to co-produce Maverick air-to-ground missiles. A factory was being built at the time of the revolution.<sup>1</sup> The future of the program has not been determined.<sup>2</sup>

7) Small arms and ammunition: Relatively little is known about this MIO industry which supplies the Iranian ground forces (IIGF) with small arms and ammunition. It is one of the oldest military industries in Iran, dating back well to 1924 and almost always under license to German contractors. During the late 1960s it developed its capabilities considerably and is now, according to Iranian sources, self-sufficient in small arms and some categories of ammunition. The factory has also reverse-engineered and produced a Soviet rocket.<sup>3</sup> The role of the German firm presently on contract to MIO and the number of third country nationals (TCNs) employed is unknown.

It is not the intent of this paper to evaluate the actual capabilities of the Iranian military or industry but to demonstrate the sequential pull toward co-production. That there were severe constraints on progress because of a limited pool of skilled labor, insufficient construction facilities, and inadequate infrastructure is a well known story. What is unknown is whether with time a viable military industrial complex could have been sustained, and whether the large amounts of equipment could have been absorbed to create a force as potent in war as it was on paper.

<sup>1</sup>A MAAG informant, July 25, 1979.

<sup>2</sup>SIPRI Yearbook, 1979, p. 165.

<sup>3</sup>Interview with General Nematì in Parchin, Iran, January 1978.

Prior to the events of 1978-79, there were signs that an "escalator of development" within the Iranian military sector was operating. According to several U.S. military observers, although the IIAF was experiencing difficulties in absorbing the newer systems, those that had had ten years or more to mature had achieved significant maintenance and operational success. In the F-5, F-4, and C-130 programs, all were reported to be manned by Iranian crews, with maintenance support provided mainly by Iranian technicians.<sup>1</sup> (One MAAG informant reported that in all three programs organizational and intermediate level maintenance had been substantially achieved and that some depot level support was in progress.) Only minimal direct U.S. or third country involvement was necessary.<sup>2</sup> Both the

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<sup>1</sup> It was estimated by one U.S. Department of Defense (DOD) official that in the F-5E/F program all units were operational and flyable at a rate close to 90%. By 1977 over 500 pilots and 1,500 maintenance personnel had been trained. A similar success was reported for the F-4 program. All F-4 units were operational and flyable at rates in the 80% range. Over 1,500 operators and 5,300 maintenance personnel had been trained. (Interview, August 1979)

<sup>2</sup> The story was very different for the newer systems. From the beginning, even on the less complex systems, Iranian operational capability exceeded its support abilities. It was estimated by both DOD and State Department officials that in 1977 a technical manpower shortage of about 7,500 personnel in the Air Force would make it difficult for Iran to support their most complex equipment. Large numbers of Americans (6,900 at the end of 1977) and third country nationals were necessary to keep them going. It was estimated that U.S. and third country technicians (for base functions of civil engineering and vehicle maintenance) would remain an important part of the Iranian defense program until 1990. Although progress was being made, time and continued foreign assistance would be necessary for the foreseeable future. In 1978, other informants suggested that there had been a significant deterioration in maintenance capability of both the F-4 and F-5 programs. The F-14 was pulling the most experienced technicians away from these earlier systems, causing an across-the-board short fall of technical manpower. A U.S. Senate report has documented the IIAF's absorption problem with the F-14. The personnel figures supplied to me by DOD and State Department officials differ from those contained in the U.S. Senate study. United States Senate. Committee on Foreign Relations. "U.S. Military Sales to Iran," A Staff Report to the Subcommittee on Foreign Assistance, July 1979, pp. 30 and 32.

F-4 and F-5 programs were cited by State Department and DOD officials as examples of the absorptive capacity of the IIAF.

Similar progress was noted for IACI. Significant achievements were reported in the IACI Executive Briefing Progress Report of September 1975. Airframe tasks had become greater and more complicated. For example, modification of the F-4 and F-5E to incorporate the leading-edge wing slat had been accomplished. Engine maintenance and overhaul performance had also progressed. By 1975 IACI was providing maintenance and overhaul for two types of engines, the J-79 and the T-59, processing 200 engines a year. At the beginning of 1974 all J-79 engine components had been sent abroad for repair and overhaul. By the end of that year, 90% of all J-79 components were being overhauled and by mid-1975 all components were repairable in-house. According to the IACI Report's evaluation, by 1975 IACI was moving toward self-sufficiency.<sup>1</sup> Iranian managers occupied 53% of the management positions, an increase of 130% over 1974. By 1977 manning figures showed approximately 2,000 Iranians, 600 third country nationals, and 50 U.S. expatriates in the employ of IACI.<sup>2</sup> During 1974 training programs had increased the number

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<sup>1</sup>It was reported by various informants that IACI employees had also built a glider by themselves, of which they were justly proud. It was considered by the Iranians as the first step toward the manufacture of airframes.

<sup>2</sup>Data supplied by the Manager of Foreign Employment for the Northrop Corporation, November 1978.

of skills certified to employees from about 50 in 1973 to 680, although a break-down of skills by nationality was not available.

The fate of the other industries listed above, as well as the expansion of IACI, are now either undetermined or cancelled. Although the seeds of a large military-industrial complex had been planted, socio-political events turned back the industrial clock for Iran. It will be difficult to assess whether an indigenous arms manufacturing capability could in fact have taken root.

In conclusion, the Iranian experience suggests that an "escalator of development" leading to some form of indigenous production is the end product of the arms transfer process.<sup>1</sup> If these stages can be detected within the Iranian military sector struggling to absorb massive shipments of weapons in a compressed time frame, this sequence may be even more typical for those LDCs with more modest and less dramatic arms transfer programs.

<sup>1</sup>Although part of the "escalator of development" is dependent on spin-offs from maintenance functions it is also dependent on leaders' motivation. The motivation to establish an indigenous arms production capability derives from such pragmatic considerations as reducing dependency on foreign powers (discussed below p. 22 ff.) and balance of payments incentives, particularly in those countries with negative trade balances. New technologies have also impacted on the motivation of third world leaders to establish a domestic arms industry. As one third world defense analyst has noted, the proliferation of Precision Guided Munitions (PGMs) and the attendant large weapons attrition rate will make resupply a critical factor on the battlefield, further fueling the perceived necessity for an autonomous supply. (Shai Feldman, "Some Observations on Indigenous Arms Production," a commentary prepared for the ACA/IISS Conference on Conventional Arms Transfers, Bellagio, Italy, May 1979, p. 5.) Ultimately, however, available resources, human and material, determine each country's success in achieving a military industrial capability.

### Make versus Buy: The Bureaucrats' Dilemma

Hypothesis 2: Dependency for third world states is no less a product of indigenous defense production than of arms transfers.

It is postulated here that decisions to "make or buy" military technology do not affect the short- or long-term dependency of recipients on suppliers. States opting for an indigenous military industrial capability are unable to produce all their required weapon systems. Instead they are forced by socioeconomic constraints to choose between what to make and what to buy. Arms transfers, therefore, do not terminate with the decision to develop a production capacity. Although a decision to produce may reduce the number of complete weapon systems imported, other kinds of technology (components, machinery, manufacturing equipment, and know-how) are transferred instead.

Freedom from foreign influence is sought by most states. One of the most obvious expressions of this desire is government support



for indigenous arms production.<sup>1</sup> For the industrializing countries, goals of "sovereignty" or "self-sufficiency" stand in constant tension with the necessity of using western know-how to foster development in military and civilian sectors.<sup>2</sup> Even LDCs blessed with substantial resources have found self-sufficiency in the military sector to be an unattainable goal. Listed below are some of the constraints limiting the indigenous arms production options of industrializing elites:

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<sup>1</sup> See Robert R. Ropelewski, "Arabs Seek Arms Sufficiency," Aviation Week and Space Technology, May 15, 1978, pp. 14-16, Donald E. Fink, "Nationalists Update Fighter Force," AWST, June 5, 1978, pp. 14-16; and [Taiwan] Center Designs Two Aircraft," AWST, May 29, 1978, pp. 14-16; Philip J. Klass, "New Capabilities Building Rapidly (Israel)," AWST, April 10, 1978, pp. 32-37; "South Korea's Industry: Boom-Boom," The Economist, December 2, 1978. See also Hugo Sada, "Arms Transfers: Dependence, Influence, and Regional Stability: Indigenous Weapons Production Capabilities," unpublished paper prepared for the ACA/IISS Conference on Conventional Arms Transfers, Bellagio, Italy, May 1979.

In this connection, Shai Feldman observes: "The greater the political costs involved in dependence, the greater the incentive to go indigenous.. Possibly the greatest accelerators of the development of indigenous arms production capabilities in Israel have been France's efforts to affect Israel's defense and policy by imposing an arms' embargo in 1967, and U.S. efforts to achieve the same by delaying shipments of supplies during the initial stages of the 1973 war." (op. cit., p. 2)

<sup>2</sup> The interrelatedness of military and civilian development for the Shah is discussed by S. Neuman, "Security, Military Expenditures and Socioeconomic Development: Reflections on Iran," Orbis, 22, no. 3 (Fall 1978), pp. 569-594. See also Shahram Chubin, "Iran's Security in the 1980's", paper presented at the International Studies Association Annual Meeting, St. Louis, Missouri, March 1977.

1) Human Resources. In Iran we have seen how shortages of managerial and technical manpower forced the Iranian government to rely on third country nationals and supplier expertise for maintaining tasks. Manpower shortages also delayed aircraft co-production plans.<sup>1</sup>

2) Size of the Military Market. Unless a large number of a particular weapons system or component is required by the armed service, or substantial export sales are anticipated, certain

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<sup>1</sup> The number of trained people necessary to build a co-production capability for sophisticated technology is suggested in the IACI expansion plan report. In order to achieve a self-sufficient maintenance and overhaul capability for the IIAF, in addition to a design and manufacturing capacity, the study estimated IACI would require 39,000 people, including 3,850 managers, 3,250 engineers, 6,000 technicians, and 24,000 other employees.

To perform just the maintenance and overhaul mission for Iran's commercial aircraft, with some second country capability, would require 9,000 employees, including 850 managers, 250 engineers, 4,000 technicians, and 4,000 other personnel. Given the context of this plan, these figures are probably conservative. (IACI Conceptual Plan, 1975)

military items are too costly to manufacture. Economies of scale are as vital for military industries as they are for civilian.<sup>1</sup>

3) Time Frame. Estimates of when a weapon is needed for projected force structure requirements and the adequacy of the lead time also affect the outcome of a "make or buy" decision.

4) Complexity of the Weapon System. Closely related to the time frame, is the technological complexity of the system to be produced. It determines whether the lead time is sufficient or not.

<sup>1</sup>For example, the IACI Report outlining a plan to establish an aerospace manufacturing industry in Iran by 1990 cautioned the Iranian government to start with light aircraft which could provide a self-supporting market without need for export. The plan called for manufacturing variants of a military trainer which would fill an internal strategic requirement, with the possibility of sales in the region as well.

The plan also pointed out that it makes little technological or economic sense to design and build aircraft already being produced by multiple sources elsewhere. Using the jumbo jet for illustration, the study showed that other sources were manufacturing enough to satisfy long-term world needs and the market demand within Iran was too small to justify a cost-effective program. Since jumbo jets provided no more advanced technology than light aircraft (such as a military trainer or short-haul transport), the report argued that buying rather than producing made more economic sense. It might be added that it also made political sense, since the availability of multiple sources of supply limited the leverage of suppliers -- which was the primary reason for production in the first place. Why manufacture if the product can be bought economically elsewhere without political penalty?

Furthermore, the IACI report warned <sup>that</sup> without a steady market of some scale the Iranian aerospace industry would be unable to avoid the peaks and valleys of employment which have impacted so negatively on the economies of other arms producing states.

5) Cost Differential. In deciding whether to "make or buy" a weapon system, governments in all LICs consider the cost differential between options. In general, the differential favors buying directly off the supplier's shelf. One reason is the cost of establishing a new factory, which is a major (non-recurring) expenditure.<sup>1</sup> Unless large numbers of the weapon system, or its components, are to be produced in-country over which non-recurring expenses can be pro-rated, the unit cost of the system remains too high to justify domestic production. Cost differentials vary among systems. Smaller military items, such as weapons and ammunition break-even earlier than larger systems. But for those LICs

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<sup>1</sup> Building a new factory for co-production of an American weapon system, for example, means buying all the tooling machinery from American firms. The real expense is associated with achieving commonality -- procuring the same equipment (e.g. jigs, milling machinery), training the personnel, acquiring a duplicate set of translated plans, etc.

interested in producing planes, according to one industry spokesman, even the smallest American tactical aircraft, such as the F-5 requires "a buy of over 200 to achieve a slight reduction in unit cost."<sup>1</sup>

6) Supporting Industrial Infrastructure. Creating an indigenous arms production capability also requires the support of many secondary industries and facilities. Building an aerospace industry, for example, entails the production of castings and forgings, fabricating sheet metal, machining, plating, as well as the manufacture of electrical and electronic equipment, gears, bearings and plastics. In order to design and develop aircraft, there is a need for certain specialized laboratory and test facilities

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<sup>1</sup>In some instances industrializing elites are willing to pay a "tuition fee" to gain know-how. Taiwan, for example, in 1973 decided to pay a cost differential of \$25 million to coproduce 250 F-5E jets. Even then Taiwan was scheduled for only about 10 percent of the production, most of which was limited to final assembly and flight testing. Domestically manufactured parts were for the nose sections only. What made even this limited coproduction plan economically feasible was the size of the procurement package. Taiwan, according to one industry informant was the only LIC to buy over 200 of any major weapon system on a coproduction basis. Brazil's decision to "buy" not "make" further illustrates the problems of scale and cost differential. In 1974, Brazil planned to acquire 42 F-5E fighter jets. The smaller number of planes to be procured, however, meant spreading the non-recurring "start-up" expenses over fewer items which escalated the cost of each plane considerably. Brazil opted to buy off-the-line rather than coproduce.

Switzerland, although not a third world country, was confronted with similar options because of its size. The Swiss decision to acquire 72 F-5Es meant that if they decided on a large coproduction program, the unit cost of each plane would rise. Yet for domestic political reasons, the Swiss opted for final assembly in Switzerland. Even though they would have to pay a cost differential it would be a relatively small one and the political trade-off was worth it. Besides an additional (government-to government) agreement had been negotiated whereby Northrop and General Electric (which builds engines for the F-5) consented to "offset" the cost differential by marketing the equivalent value of Swiss industrial products abroad. (Information gathered from interview with industry executive, October 1979, and Captain R. Kenneth Bowers, USAF, "Coproduction: The U.S. F-5E in Taiwan and Switzerland," Defense Systems Management Review, vol. 2, no. 2 (Spring 1979), pp.34-45.

as well, (e.g. engineering test laboratories, wind tunnels, flight simulators, etc.). The decision to "make" often means developing these secondary facilities, a task that may be beyond the technical and economic capabilities of a less industrialized country.

How these considerations affect "make or buy" options in the LICs is illustrated by the Iranian decision not to attempt coproduction of the F-5 jet in the early 1970s and a more sophisticated fighter in the 1990s. Time was an important factor in the Iranian decision. Acquiring an indigenous capability for fighter production is a lengthy and complex process. (India had 20 years of experience with the Marut before the government and industry experimented with a more sophisticated aircraft.<sup>1</sup>) Although the F-5 was and is considered to be an "intermediate" technology,<sup>2</sup> projected strategic requirements were expected to outpace the Iranian

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<sup>1</sup>The newer Ajeet is a Mach II version of the license-built British Gnat. See Gregory Copley, "Third World Arms Production," Defense and Foreign Affairs Digest, September 1978, pp. 24-41, for a description of India's military industry.

<sup>2</sup>The term "intermediate technology" is a relative one. The most advanced defense technology extant determines the relative sophistication of other military items. Therefore the meaning of "intermediate", or for that matter other descriptors of military hardware such as "advanced", "critical", "lead-edge", or "vintage" is constantly changing. In a recent interview, a U.S. government official defined "intermediate" weapon systems as subsonic jet aircraft, transport aircraft, medium and light armored vehicles, missile patrol boats, frigates, patrol submarines, tactical missile systems, radars, and battlefield electronics. He noted, however, that in the third world, for many countries these are "advanced" systems. Only a few of the LICs can produce a few of them. None can produce all of them. (Interview with U.S. Department of State official, November 1979.

Nevertheless, over time, there is a steady upgrading of the level of weaponry throughout the world. Today's "advanced" technology is tomorrow's "intermediate" level weapon system. Third world countries are constantly modernizing older military items with new components. One example is Korea's effort to increase its military capabilities. With U.S. assistance, South Korea has improved Western Electric Nike Hercules missiles previously furnished to Korea by the U.S. These modifications include, "upgrading some electronics to solid state for improved reliability, improved conventional warhead munitions, and the capability to operate the missiles in a ground-to-ground mode." (See Bruce A. Smith, "Koreans Seek New Military Air Capability," Aviation Week and Space Technology, Oct. 22, 1979, pp. 62-3

manufacturing capability. They chose not to invest years learning how to produce an aircraft which would be unsuited to their future defense needs. Instead the Iranians opted to buy F-5s until acceptable levels of maintenance and logistics management were attained for the IIAF inventory. Their goal was to achieve intermediate level maintenance capacity for high technology planes and depot level for the F-5. In 1975, plans to co-produce (assemble, with some fabrication) other aircraft, including ultimately an indigenously designed and developed F-X<sup>1</sup>, were also deferred. This time technical manpower shortages and the size of the projected capital investment<sup>2</sup> (to train men and build supporting facilities) moved the Shah to declare it was "too much, too soon."<sup>3</sup>

Even after the basic decision to "make or buy" a system has been taken, other second and third level choices are necessary. For example, when it is decided to produce rather than purchase, a determination must be made as to which of the supporting technologies, equipment, skills, and other capacities will be developed internally or acquired abroad. If, on the other hand,

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<sup>1</sup>Acronym for an "experimental fighter".

<sup>2</sup>The OPEC price increase during 1973-74 precipitated a worldwide economic recession. Iranian oil sales began to decline. By 1975 they had dropped 12.5%. See Michael T. Klare, "Arms and the Shah," The Progressive, August 1979, p. 20.

<sup>3</sup>Interview with Northrop Corporation Manager of Support Services, August 20, 1979.

the decision has been made to buy equipment, the infrastructure necessary to accomodate the technologies must be obtained. Whether to use foreign or domestic capital for investment raises still a third layer of economic and political trade-off questions for policy-makers.

For example, IACI developed a matrix for the government of Iran which estimated that no less than 80 different kinds of resources and equipment were needed to support a decision to "make" rather than "buy" an advanced fighter jet by 1990. Of these resources, fourteen were available only in the U.S. or Europe, and others, although obtainable in-country, were less expensive to purchase from western sources. However, as the study pointed out, "make or buy" decisions are fluid and change over time. A decision to procure all items outside of Iran can be phased into all-make in Iran, given a long enough time frame using license arrangements. Time in which to develop capabilities changes the long-term cost-effectiveness picture considerably. ¶ Decisions to "make or buy" are part of an ongoing process of trade-offs between self-sufficiency and development in the less industrial countries. The implications of these decisions reach beyond individual country borders into the larger international system.

### Conclusion

Because conventional arms transfer relations involve dependency for the recipient, building an indigenous arms production capability represents an attempt on the part of less industrialized states to reduce supplier leverage. But as this paper has demonstrated, self-sufficiency in weapons production is beyond the reach



of less developed countries. Domestic production creates other dependencies.

It can be argued that in an interdependent environment, sovereignty is unattainable for even the most industrialized states. But in the real world of inequality, where resources are inequitably distributed, dependence and independence are relative not absolute values. Well endowed states have more leverage than other states. For the smaller, poorer countries, the choice between arms production and arms transfers implies only greater or less dependency.

The implications of both the "escalator of development" and co-production/dependency relationships for U.S. arms transfer and control policies are examined below. For discussion purposes, two policy recommendations, derived from the above argument, are presented here. They form the basis for the concluding discussion and will be developed more fully in another paper to be submitted later this year:

1. To help less industrialized countries avoid the negative consequences of buying or producing equipment beyond their means, U.S. policy should encourage the design and manufacture of intermediate level major weapon systems in the U.S. created specifically for export;
2. Existing co-production guidelines should be changed to permit allies and friends to make their own determinations regarding their coproduction needs. A more liberal coproduction policy is recommended.

#### Conclusion: Policy Implications for the United States

What then does the foregoing discussion imply for U.S. arms transfer and coproduction policy? On May 19, 1977, President Carter enunciated two goals for U.S. policy: first, to "utilize arms transfers to promote our security and the security of our close friends," and second, a policy of restraint in arms transfers,

"using them as an exceptional foreign policy instrument." Six controls were enumerated to serve as guidelines for this policy. Of these, two are particularly related to our discussion here:

3. Development or significant modification of advanced weapons systems solely for export will not be permitted.

4. Coproduction agreements for significant weapons equipment, and major components (beyond assembly of subcomponents and the fabrication of high-turn-over spare parts) are prohibited.

However, if the hypotheses developed in this paper are relevant to industrializing countries in general, then it follows that both these control measures are counterproductive for U.S. policy goals.

First, by restricting less industrial countries to the purchase of arms already in U.S. inventory, Point 3 impels these states to purchase arms which are often more sophisticated than they require. More importantly, however, it denies to these countries the option of buying equipment which is suited to their particular strategic, climatic, and economic needs. If anything, a restrictive policy of this kind stimulates third world leaders to "make" more when it may be economical to "buy" more. All third world countries do not need or want the most advanced technologies in their force structures. The regional environment, as well as the internal structure of the military, may make state-of-the-art weapon systems (such as the F-16) unnecessary to purchase or produce. But when there are no appropriate alternatives, those that can afford to purchase them do so.

Second, all industrializing countries cannot afford to buy high level technologies, and may require intermediate level major military items which a more industrialized country does not

manufacture for its own military. (Some resource-rich countries are able to absorb the expense of purchasing many sophisticated weapons, taking years to learn to use them, but for the majority of third world countries this is not a viable option.) The rising costs of weapons produced in the West, particularly in the U.S., is a response to the demand from U.S. services that these systems successfully perform 95% of all conceivable missions. Poorer states are likely to prefer weapon systems that can carry out 70-80% of conceivable missions.<sup>1</sup> They are also likely to prefer weapon systems designed with their peculiar missions and conditions in mind. Thus, restrictions on developing weapon systems for export only may create incentives for recipients to either buy bigger or make more than is cost effective.

Past U.S. experience with the F-5 has shown that making available less expensive, less complicated technology suited to the needs of recipients is in the interest of both U.S. arms control and security goals. The evidence presented in this paper suggest there is little reason not to continue this policy, with, perhaps, one addition--the participation of recipients in the R&D process. Inviting the less industrialized countries to participate in the design of equipment for their own use (such as an F-X plane,<sup>2</sup> or a next generation tank, etc.) will not end dependency, whether they decide to make or buy the system. But for third world leaders, if the end product meets their economic and defense needs, the benefits of dependency may outweigh the

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<sup>1</sup> Shai Feldman, "Some Observations on Indigenous Arms Production," prepared for the ACA/IISS Conference on Conventional Arms Transfers, Bellagio, Italy, May 1979.

<sup>2</sup> For example, countries with older F-5s in their inventories are now searching for a more modern replacement to deal with changing defense needs. For many the F-4 and F-16 are too sophisticated for their needs and capabilities, and a new generation intermediate fighter aircraft is not available in U.S. inventories.

costs.<sup>1</sup>

Point 4 of the 1977 arms policy statement also needs to be reexamined in the light of U.S. policy goals. This paper has tried to demonstrate that there is little suppliers can do to halt the "escalator of development" in industrializing countries. In any event there is some question as to whether supplier gain anything by doing so. A liberal U.S. co-production policy--allowing recipients the freedom to decide what they want to make or buy--which prohibits only the transfer of "critical technologies,"<sup>2</sup> may in the long run help to restrain the transfer of sophisticated weapons and promote the security of our allies. Internal constraints within the small economies place real limits on their options. It is unnecessary for the U.S. to legislate them.

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<sup>1</sup> Although the Carter administration has since reversed itself on the question of the F-X, the decision was considered an exception to rather than a change of the policy enunciated in Point 3. The above argument suggests a reconsideration of that policy.

<sup>2</sup> Maurice J. Mountain, "Technology Exports and National Security," Foreign Policy, no. 32 (Fall 1978), 95-103, maintains it is feasible to identify most, if not all, critical technologies. He defines them as those weapon systems in which the U.S. and its allies now have, or are likely to have, a margin of technological superiority over the USSR and Warsaw Pact countries. "To be critical, it is not enough that a technology be essential or unique to the particular product or weapons system to which it applies, but it must also be sufficiently esoteric to be known only to a few." (p. 96)